

## REMARKS

This is intended as a full and complete response to the Final Office Action dated February 28, 2007, having a shortened statutory period for response set to expire on May 28, 2007. Please reconsider the claims pending in the application for reasons discussed below.

### CLAIM REJECTIONS

#### **35 U.S.C. §103(a) Claims 8-9 and 37-44**

Claims 8-9 and 37-44 stand rejected as being unpatentable over *Miura* (U.S. Patent Publication No. 2003/0155247) in view of *Dubin* (U.S. Patent No. 6432821) and further in view of *Wang* (U.S. Patent No. 6528412). The Applicants respectfully disagree.

Independent claim 8 recites elements not taught or suggested by the combination of *Miura*, *Dubin* and *Wang*. *Miura* teaches using an electroplating solution having a suitable PH value to prevent a copper seed layer from dissolved in the plating solution. As described in Paragraph 8, Lines 8-11 of *Miura's* specification, "electric current may not be able to flow through the trenches or via holes due to the missing seed layer and copper deposition may not take place at all, resulting in defects in plate." Therefore, *Miura* teaches using a conductive seed layer disposed on a substrate prior to a copper electroplating deposition process to provide enough required electric current to enable the copper electroplating deposition process. See Paragraph 13, Lines 6-9 and paragraph 14, lines 7-9. The conductive seed layer is formed by PVD or CVD. See Paragraph 50, Lines 3-6.

The Examiner cites Page 4, Paragraph 51, Lines 7-12 of *Miura* for the proposition that "when the subsequent electrolytic copper plating process reinforces and adds thickness to the seed layer, there is no reason why the subsequent electrolytic copper plating process is not an electroplating of the seed layer." See Page 3, Lines 15-17 of Office Action. The Applicants respectfully disagree.

Firstly, as admitted by the Examiner, the subsequent electrolytic copper plating process is reinforcing and adding thickness to an existing copper seed layer disposed on the substrate. Therefore, all the subsequent electrolytic copper plating process is performed on a previously deposited copper seed layer because without the previously deposited copper seed layer, "electric current may not be able to flow through the trenches or via holes due to the missing seed layer and copper deposition may not take place at all, resulting in defects in plate." See Paragraph 8, Lines 8-11 of *Miura's* specification. Therefore, *Miura* does not teach or suggest electrolytic copper plating a copper seed layer. In contrast, *Miura* teaches that a prior deposited copper seed (deposited by CVD or PVD process) must be present to enable the subsequent electrolytic copper plating process.

Secondly, the Examiner asserts that there is no reason why the subsequent electrolytic copper plating process is not an electroplating of the seed layer. The Applicants submit that the subsequent electrolytic copper plating process described by *Miura* is used to deposit bulk copper layer to fill in the vias/trenches, not depositing a seed layer. The subsequent electrolytic copper plating process is merely enhancing the thickness of a prior deposited copper seed layer and the electrolytic copper solution is selected at a suitable range to prevent the existing seed layer from dissolved, thereby preventing the thickness of the seed layer being reduced while immersing in the electrolytic copper solution. Since *Miura* specifically teaches the subsequent electrolytic copper plating process cannot be performed without the electric current provided through the seed layer, *Miura* can not teach or suggest electrolytic copper plating of seed layer, as asserted by the Examiner. *Miura* specifically teaches using seed layer deposited by a PVD or CVD process to enable the subsequent electrolytic copper plating process, as the uniform electric current prevents forming of void and defects during the subsequent electrolytic copper plating process. Therefore, *Miura* does not teach or suggest depositing a copper seed layer onto a barrier surface by an electroplating process, as claimed in the present application.

The Applicants additionally submit that the standard for claim interpretation during the examination of a patent application by the U.S. Patent and Trademark Office is that "claims ... are to be given their broadest reasonable interpretation consistent with

the specification, and ... claim language should be read in light of the specification as it would be interpreted by one of ordinary skill in the art." Moreover, this interpretation must be consistent with one that would be reached by those skilled in the art. In re American Academy of Science Tech Center, 367 F.3d 1359, 1365; 70 U.S.P.Q. 2D (BNA) 1827 (Fed. Cir. 2004), citing In re Bond, 910 F.2d 831, 833 (Fed. Cir. 1990) and In re Cortright, 165 F.3d 1353, 1358 (Fed. Cir. 1999) (emphasis added). In the present application, the claims have not been interpreted in a manner consistent with the specification nor in a manner consistent with an interpretation that would be utilized by those skilled in the art. In particular, a skilled artisan would not interpret using a PVD or CVD deposited seed layer which enables a subsequent electrolytic copper plating process as taught by *Miura* to be suggestive of depositing a copper seed layer onto a barrier surface by an electroplating process, as claimed in the present application. Therefore, the Applicants submit that the Examiner has neglected to consider how one skilled in the art would interpret the claim language in light of the specification.

*Dubin* teaches using multiple steps to electroplating copper on a seed layer. The multiple steps electroplating copper process has an initial step to repair discontinuities in the copper seed layer. Similar to the teaching of *Miura* discussed above, neither *Dubin* nor *Miura*, alone or in combination, teaches or suggests depositing a copper seed layer onto a barrier surface by an electroplating process, as claimed in the present application.

*Wang* teaches CVD or ALD depositing an adhesion skin layer on a barrier layer on a substrate. Subsequently, an electroplating process, e.g., a wet process, may be performed to deposit a seed layer on the adhesion skin layer. Therefore, the seed layer as taught by *Wang* is deposited on an adhesion skin layer particularly chosen to match the seed layer for promoting adhesion between the layers. The seed layer as taught by *Wang* is not deposited on a barrier layer.

The Examiner asserts that there is a motivation to combine the seed layer as taught by *Wang* into the PVD seed layer as taught by *Miura* to resolve the discontinuity issue of *Miura*'s PVD seed layer. The Applicants respectfully disagree.

The seed layer as taught by *Wang* is deposited on a specifically selected adhesion skin layer, not on a barrier layer. It is well known in the art that different

materials have different wettabilities, and the wettability of a material has significant influence to adhesion and interfacial reaction for layers subsequently deposited on. Accordingly, a careful selection of using a wet process or a dry process to deposit a first material on a second material is critical to ensure a good interfacial bonding between materials. As specifically noted in *Wang*, the wet process of depositing a seed layer is selected to deposit on a carefully chosen adhesion skin layer to promote adhesion. There is no motivation to combine *Wang's* wet process seed layer into *Miura's* PVD seed layer to reinforce and add the thickness of the *Miura's* PVD seed layer because *Wang's* wet process seed layer is designed to adhere and deposit on the accompanying underlying adhesion skin layer. The Federal Circuit has held that "if [a] proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984); *see also*, MPEP §2143.01. Here, as the wet process seed layer as taught by *Wang* is selected to react with and adhere on a careful chosen adhesion skin layer, there is no suggestion or motivation to combine *Wang's* wet process seed layer to modify, *e.g.*, reinforce and add thickness, the PVD seed layer as taught by *Miura* because the modification will make *Wang's* wet process seed layer unsatisfactory for its intended purpose. Even though *Wang's* wet process seed layer could be combined to reinforce and add thickness to the PVD seed layer as taught by *Miura*, the resultant process would not yield depositing a copper seed layer onto a barrier surface by an electroplating process, as claimed in the present application.

Thus, the Applicants submit that independent claim 8, and all claims depending therefrom, are patentable over *Miura* in view of *Dubin* and further in view of *Wang*. Accordingly, the Applicants respectfully request the rejection be withdrawn and the claim allowed.

### **35 U.S.C. §103(a) Claim 10**

Claim 10 stands rejected as being unpatentable over *Miura* in view of *Dubin*, and further in view of *Wang* and *Nagai* (U.S. Patent No. 6709563). The Applicants respectfully disagree.

Independent claim 8 recites elements not taught or suggested by the combination of *Miura*, *Dubin*, *Wang* and *Nagai*. The patentability of claim 8 over *Miura*, *Dubin*, and *Wang* has been discussed above. *Nagai* teaches a plating liquid containing divalent copper ions, a completing agent and an optional pH adjusting agent. However, there is no teaching or suggestion from *Nagai* that would suggest to one of ordinary skill in the art to modify *Miura*, *Dubin*, and *Wang* in a manner that would yield depositing a copper seed layer onto a barrier surface by an electroplating process, as recited by claim 8.

Thus, the Applicants submit that claim 10, that depends from claim 8, is patentable over *Miura* in view of *Dubin* and further in view of *Wang* and further in view of *Nagai*. Accordingly, the Applicants respectfully request the rejection be withdrawn and the claim allowed.

### **35 U.S.C. §103(a) Claims 20-21 and 45-52**

Claims 20-21 and 45-52 stand rejected as being unpatentable over *Miura* in view of *Dubin*, and further in view of *Wang*. The Applicants respectfully disagree.

As discussed, the combination of *Miura*, *Dubin* and *Wang* does not teach or suggest depositing a copper seed layer onto a barrier surface by an electroplating process, as recited by independent claim 21. As such, a *prima facie* case of obviousness has not been established as the references fail to teach each claimed elements.

Thus, the Applicants submit that claim 20, and claims 21 and 45-52 depending therefrom, are patentable over *Miura* in view of *Dubin* and further in view of *Wang*. Accordingly, the Applicants respectfully request the rejection be withdrawn and the claim allowed.

### **35 U.S.C. §103(a) Claim 22**

Claim 22 stands rejected as being unpatentable over *Miura* in view of *Dubin* and further in view of *Wang* and *Nagai*. The Applicants respectfully disagree.

As discussed, the combination of *Miura*, *Dubin* and *Wang* and *Nagai* does not teach or suggest depositing a copper seed layer onto a barrier surface by an electroplating process, as recited by independent claim 20, from which claim 22

depends from. As such, a *prima facie* case of obviousness has not been established as the references fail to teach each claimed elements.

Thus, the Applicants submit that claim 22, that depends from claim 20, is patentable over *Miura* in view of *Dubin* and further in view of *Wang* and in view of *Nagai*. Accordingly, the Applicants respectfully request the rejection be withdrawn and the claim allowed.

### **35 U.S.C. §103(a) Claims 31-32 and 53-58**

Claims 31-32 and 53-58 stand rejected as being unpatentable over *Miura* in view of *Dubin* and further in view of *Wang*. The Applicants respectfully disagree.

As discussed, the combination of *Miura*, *Dubin* and *Wang* does not teach or suggest depositing a copper seed layer onto a barrier surface by an electroplating process, as recited by independent claim 31. As such, a *prima facie* case of obviousness has not been established as the references fail to teach each claimed elements.

Thus, the Applicants submit that independent claim 31, and claims 32 and 53-58 depending therefrom, are patentable over *Miura* in view of *Dubin* and further in view of *Wang*. Accordingly, the Applicants respectfully request the rejection be withdrawn and the claim allowed.

### **35 U.S.C. §103(a) Claim 33**

Claim 33 stands rejected as being unpatentable over *Miura* in view of *Dubin* and further in view of *Wang* and *Nagai*. The Applicants respectfully disagree.

As discussed, the combination of *Miura*, *Dubin* and *Wang* does not teach or suggest depositing a copper seed layer onto a barrier surface by an electroplating process, as recited by independent claim 31, from which claim 33 depends. As discussed above, *Nagai* does not bridge the deficiencies of the combination of *Miura*, *Dubin* and *Wang*. As such, a *prima facie* case of obviousness has not been established as the references fail to teach each claimed elements.

Thus, the Applicants submit that claim 33, that depends from claim 31, is patentable over *Miura* in view of *Dubin* and further in view of *Wang* and in view of

*Nagai*. Accordingly, the Applicants respectfully request the rejection be withdrawn and the claim allowed.

### **35 U.S.C. §103(a) Claim 59**

Claim 59 stands rejected as being unpatentable over *Miura* in view of *Dubin* and *Wang*, and further in view of *Dubin* ('217) (U.S. Patent Publication No. 2004/0108217). The Applicants respectfully disagree.

As discussed, the combination of *Miura*, *Dubin* and *Wang* does not teach or suggest depositing a copper seed layer onto a barrier surface by an electroplating process, as recited by independent claim 31. *Dubin* ('217) teaches electroplating a copper layer for metal interconnection. However, there is not teaching or suggestion from *Dubin* ('217) that would suggest to one of ordinary skill in the art to modify *Miura*, *Dubin* and *Wang* in a manner that would yield depositing a copper seed layer onto a barrier surface by an electroplating process, as recited by claim 59. As such, a *prima facie* case of obviousness has not been established as the references fail to teach each claimed elements.

Thus, the Applicants submit that independent claim 59, is patentable over *Miura* in view of *Dubin* and further in view of *Wang* and further in view of *Dubin* ('217). Accordingly, the Applicants respectfully request the rejection be withdrawn and the claim allowed.

### **NEW CLAIM**

The Applicants have added new claim 60. The Applicants believe that the new claim is fully supported by the specification and is patentable over the references of record. Thus, the Applicants submit that no new matter has been added and respectfully request allowance of these claims.

### **CONCLUSION**

Thus, for at least the reasons discussed above, the Applicants submit that all claims now pending are in condition for allowance. Accordingly, both reconsideration of this application and its swift passage to issuance are earnestly solicited.

If, however, the Examiner believes that any unresolved issues still exist, it is requested that the Examiner telephone Mr. Keith Taboada at (732) 530-9404 so that appropriate arrangements can be made for resolving such issues as expeditiously as possible.

Respectfully submitted,

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